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RESEARCH INTERESTS AND SPECTROSCOPIES

Magnetic materials, Interfacial magnetic properties, CMR materials, High temperature superconductivity, polarons, structural and magnetic phase transitions, metal-insulator transition, amorphous materials; X-ray Magnetic Circular Dichroism (XMCD), X-ray Resonant Exchange Scattering (XRES), X-ray Absorption Fine Structure (XAFS), X-ray Magnetic Microscopy, Electron Energy Loss Spectroscopy (EELS), Mössbauer Spectroscopy, Electron Microscopy .

CURRENT RESEARCH ACTIVITIES

I am currently focused on the development of x-ray techniques that use circularly polarized x-rays to study magnetic materials. These include Magnetic Reflectivity for studies of interfacial structure, Magnetic DAFS for studies of element- and site- specific magnetism, Magnetic-XAFS for studies of local magnetic ordering, and Magnetic microscopy for imaging and characterization with micron resolution.

EMPLOYMENT

Assistant Physicist

Argonne National Laboratory

June 2001 - present

Post-doctoral Research Associate

Argonne National Laboratory

August 1999 - May 2001

University of Washington

March 1998 - July 1999

EDUCATION

Ph.D. in Physics

University of Washington

1998

Thesis: *Local Structural Studies of Oriented High Temperature Superconducting Cuprates by Polarized XAFS spectroscopy*

Advisor: Edward A. Stern

M.Sc. in Physics

Technion, Israel

1992

Thesis: *Effect of impurities on dynamical properties of dilute metallic binary alloys*

Advisor: Hanan Shechter

B.Sc. in Physics

Technion, Israel

1989

RESEARCH EXPERIENCE

X-ray studies of magnetic interfacial properties in multilayers

Combined x-ray resonance exchange scattering and magnetic circular dichroism techniques to measure and quantify both the spatial extent and strength of magnetic exchange coupling at the interfaces of layered structures. Two major computer codes were developed to extract reliable quantitative information from the data: (1) a generalized fitting algorithm to model magnetic reflectivity within the first Born approximation, including magnetic and charge roughnesses, absorption and refraction corrections and error estimates and (2) a generalized differential Kramers-Krönig algorithm to obtain accurate charge and magnetic anomalous scattering factors near absorption edges. In addition to obtaining long sought-after information on the exchange coupling at Gd/Fe interfaces, the generalized algorithms allow obtaining similar information for other technologically relevant magnetic structures.

XAFS studies of local structural properties of high T_c superconductors

Used the orientation dependence of X-ray Absorption Fine Structure (XAFS) in anisotropic structures to measure atomic arrangements in oriented high T_c superconductors, particularly at structural and superconducting phase transitions and around dopant atoms. Developed methods for preparation of magnetically aligned powders for experiments in fluorescence geometry. Performed measurements as a function of temperature, chemical doping and pressure at different synchrotron radiation sources (NSLS, SSRL, APS). These measurements revealed, among others, the polaronic nature of hole carriers doped by Sr in $\text{La}_{2-x}\text{Sr}_x\text{CuO}_4$, the high spin non Jahn-Teller state of Ni in $\text{La}_{2-x}\text{Sr}_x\text{Cu}_{1-y}\text{Ni}_y\text{O}_4$ and the large local disorder in tilt angle of CuO_6 octahedra present in $\text{La}_{1.875}\text{Ba}_{0.125}\text{CuO}_4$.

Electron microscopy studies of local atomic structure of materials

Contributed to the development of the EXELFS technique (Extended Energy Loss Fine Structure) as a structural tool with high spatial resolution ($50 \text{ \AA} - 1 \mu\text{m}$) in the Transmission Electron Microscope (TEM). Main contributions include improvements in data analysis and quantifying the effect of electron radiation damage as a limitation to high spatial resolution. Performed several experiments on different classes of materials on a Philips 430 TEM equipped with a 666 GATAN magnetic sector. Used electron diffraction and imaging to supplement the information obtained in the electron energy loss spectra. Experience with sample preparation techniques for the TEM, including ion-milling and jet electro-polishing.

Mössbauer studies of impurities in metals

Used Mössbauer spectroscopy on the ^{119}Sn isotope to study local dynamics and electronic properties of Sn impurities in Ag, Pb and Au metal hosts. Performed experiments at low ($4 - 300\text{K}$) and high ($300 - 1000\text{K}$) temperatures and as a function of Sn concentration. Larger than expected dynamical activity of the Sn atoms was found at high temperatures, providing new clues into the role of point defects on lowering the melting temperature of dilute binary alloys. Experience in preparing metallic alloys as well as in grain structure measurements (SEM, optical microscopy) of polycrystalline samples.

Other Research Projects

X-ray microscopy studies of magnetic domains: Actively involved in studies of magnetic domain structures in materials of current technological interest by means of a circularly polarized hard x-ray microprobe. The microprobe couples phase retarder optics with K-B mirrors to obtain $\approx 1\mu\text{m}$ spatial resolution. In addition to mapping the magnetic domain structure as function of applied field in a SmCo buried layer of a Fe/SmCo spring magnet, micro-XANES and elemental mapping are currently used to correlate chemical and magnetic properties. The microscope is also being used in studies of magnetization reversal of patterned, sub-micron, pseudo-spin valve structures.

Structural studies of magnetic crystalline and amorphous materials: Performed XAFS experiments and analysis on single crystals of Colossal Magneto-Resistance (CMR) $\text{La}_{1.2}\text{Sr}_{1.8}\text{Mn}_2\text{O}_7$ and $\text{La}_{0.875}\text{Sr}_{0.125}\text{MnO}_3$ with the aim at elucidating the interplay between structure, magnetic and electrical properties. Performed XAFS experiments and analysis on crystalline and amorphous $\text{BaFe}_{12}\text{O}_{19}$ in order to investigate atomic short range order in the low-temperature synthesized (200 °C) amorphous phase and its relation to the magnetic properties of this material. Performed XAFS experiments and analysis on amorphous magnetic semiconductor $\text{Si}_{1-x}\text{Gd}_x$ to correlate local structure and magnetic properties.

Development of software: Wrote a generalized code to correct X-ray Absorption Near Edge Structure (XANES) data for self absorption effects in fluorescence experiments. Wrote a generalized code to fit magnetic reflectivity data within the first Born approximation. Wrote a generalized Kramers-Krönig code to obtain accurate charge and magnetic anomalous scattering factors.

TEACHING EXPERIENCE

2001-present Joint supervision of Post-doctoral appointees and graduate students

1992-1993 Teaching assistant, University of Washington

Lead problem session of electrodynamics courses for advanced undergraduate students.

1989-1990 Teaching assistant, Technion, Israel

Laboratory instructor for introductory physics classes.

COMPUTER EXPERTISE

Experience in FORTRAN and C programming. Experience with script language programming (PERL, C-shell) as well as working knowledge of UNIX, LINUX and Windows-NT operating systems and a variety of software running on these platforms.

LANGUAGES

Fluent in English, Hebrew and Spanish.

AWARDS

2000 International Union of Crystallography Young Scientist Award.

SELECTED PUBLICATIONS

- XAFS study of local disorder in the α -Gd_xSi_{1-x} amorphous magnetic semiconductor*,
D. Haskel, J. Freland, J. Cross, R. Winarski, M. Newville and F. Hellman
Physical Review B, *in press* (March 2003).
- Magnetization reversal in ferromagnetic antidot arrays by vector magnetometry with XMCD*,
D. R. Lee, Y. Choi, C-Y. You, J. Lang, D. Haskel, V. Metlushko, S. Bader and G. Srajer
Applied Physics Letters **81**, 4997 (2002)
- X-ray absorption spectroscopy of the cubic and hexagonal polytypes of ZnS*,
B. Gilbert, B. Frazer, H. Zhang, F. Huang, F. Banfield, D. Haskel, J. Lang, G. Srajer, G. De Stasio
Phys. Rev. B **66**, 245205 (2002)
- X-ray diffraction study of lattice modulations in an underdoped YBa₂Cu₃O_{6+x} superconductor*,
Z. Islam, S. Sinha, D. Haskel, J. Lang, G. Srajer, B. Veal, D. Haefner and H. Mook
Phys. Rev. B **66**, 092501 (2002)
- Local Structure in the Stripe phase of La_{1.6-x}Sr_xNd_{0.4}CuO₄*,
S. H. Han, E. A. Stern, D. Haskel and A. R. Moodenbaugh
Phys. Rev. B **66**, 094101 (2002)
- Enhanced Interfacial Magnetic Coupling of Gd/Fe Multilayers*,
D. Haskel, G. Srajer, J. Lang, J. Pollmann, C. Nelson, J. S. Jiang, and S. D. Bader
Phys. Rev. Lett. **87**, 207201 (2001)
- Magnetic imaging of a buried SmCo layer in a spring magnet*,
J. Pollmann, G. Srajer, D. Haskel, J. C. Lang, J. Maser, J. S. Jiang, and S. D. Bader
J. Appl. Phys. **89**, 7165 (2001).
- Ni-induced local distortions in La_{1.85}Sr_{0.15}Cu_{1-y}Ni_yO₄ and their relevance to T_c suppression:*
An angular-resolved XAFS study
D. Haskel, E. A. Stern, V. Polinger and F. Dogan
Phys. Rev. B **64**, 104510 (2001).
- Dopant structural distortions in high-temperature superconductors: an active or a passive role?*,
D. Haskel, E. A. Stern, F. Dogan, and A. R. Moodenbaugh
J. Synchrotron Rad. **8**, pp. 186-190 (2001).
- Nanoscopic fluctuational dynamic model of anomalous temperature and composition dependences in the Sn Mössbauer isomer shift in Ag-Sn alloys*,
Y. Khait, I. Snapiro, H. Shechter and D. Haskel
J. Phys. : Condens. Matter **12**, pp. 7275-7285 (2000).
- XAFS study of the low-temperature tetragonal phase of La_{2-x}Ba_xCuO₄: Disorder, stripes, and T_c suppression at x = 0.125*,
D. Haskel, E. A. Stern, F. Dogan and A. R. Moodenbaugh
Phys. Rev. B **61**, pp. 7055-7076 (2000).
- Towards nanoscale EXELFS analysis: limitation due to radiation damage*,
D. Haskel, M. Sarikaya, M. Qian and E. A. Stern
Micron **30**, p. 185 (1999).
- Anomalous concentration dependence in the ¹¹⁹Sn Mössbauer isomer shift of Ag-Sn alloys*,
H. Shechter, D. Haskel, E. A. Stern and Y. Yacoby,
J. Phys.: Condensed Matter **10**, p. 8573 (1998).
- Comment on "Tilting of the CuO₆ octahedra in La_{1.83-x}Eu_{0.17}Sr_xCuO₄ as seen by ¹⁵¹Eu Mössbauer spectroscopy"*,
D. Haskel, E. A. Stern and H. Shechter,
Phys. Rev. B. **57**, p. 8034 (1998)

- X-ray-absorption fine-structure study of the B1-to-B2 phase transition in RbCl*,
S. Kelly, R. Ingalls, F. Wang, B. Ravel and D. Haskel,
Phys. Rev. B. **57**, p. 7543 (1998).
- Altered Sr environment in $La_{2-x}Sr_xCuO_4$* ,
D. Haskel, E. A. Stern, D. G. Hinks, A. W. Mitchell and J. D. Jorgensen,
Phys. Rev. B. (Rapid Communications) **56**, p. R521 (1997).
- Local structural changes in $KNbO_3$ under high pressure*,
A. I. Frenkel, F. M. Wang, S. Kelly, R. Ingalls, D. Haskel and E. A. Stern,
Phys. Rev. B. **56**, p. 10869 (1997).
- Dopant and temperature induced structural phase transitions in $La_{2-x}Sr_xCuO_4$* ,
D. Haskel, E. A. Stern, D. G. Hinks, A. W. Mitchell, J. D. Jorgensen and J. I. Budnick,
Phys. Rev. Lett. **76**, p. 439 (1996).
- Are nanophase grain boundaries anomalous?*,
E. A. Stern, R. W. Siegel, M. Newville, P. G. Sanders and D. Haskel,
Phys. Rev. Lett. **75**, p. 3874 (1995).
- EXELFS as a tool for quantifying phase distributions in materials*,
D. Haskel, M. Sarikaya, M. Qian and E. A. Stern,
Ultramicroscopy **58**, p. 353 (1995).
- Anomalous temperature behavior of Sn impurities*,
D. Haskel, H. Shechter, E. A. Stern, M. Newville and Y. Yacoby
Phys. Rev. B **47**, p. 14032 (1993).

INVITED AND CONTRIBUTED CONFERENCE PRESENTATIONS

- (Invited Talk) Using Circularly Polarized X-rays to Study Layered Magnetic Nanostructures*
Symposium on *Impact of Scattering on Nanoscience and Technology*, American Crystallographic Association annual meeting (ACA 02) San Antonio, Texas (2002).
- (Talk) Hard x-ray MCD studies of a surface-driven twisted state in artificial Gd/Fe ferrimagnetic multilayers*
DOE Annual Workshop on Nanocomposite Magnetic Materials, Stony Brook, NY, USA (2002).
- (Talk) Hard x-rays MCD studies of magnetic phase transitions- with a twist*
47th conference on Magnetism and Magnetic Materials, MMM02, Tampa, FL, USA (2002).
- (Talk) Local Structure of amorphous V-TCNE molecular magnet*
March Meeting of the American Physical Society, Indianapolis, USA (2002)
- Direct observation of surface-driven twisted state in an Fe-terminated $[Gd(50 \text{ \AA})Fe(35 \text{ \AA})]_{15}$ multilayer*
March Meeting of the American Physical Society, Indianapolis, USA (2002)
- (Invited Talk) XAFS in anisotropic structures: Exploiting angular dependence for better modeling*
Workshop on *Advanced methods and tricks for XAFS data modeling*, NSLS annual user meeting, Brookhaven, NY, May 2001
- (Talk) X-ray resonance exchange scattering and magnetic circular dichroism study of the magnetic structure of a $[Gd(50 \text{ \AA})Fe(15 \text{ \AA})]_{15}$ multilayer*
March Meeting of the American Physical Society, Seattle, WA, USA (2001)
- (Invited Talk) Dopant structural distortions in high T_c superconductors: Active or Passive role?*
The 11th International Conference on X-ray Absorption Fine Structure, Ako, Japan (2000)
- (Talk) Charge Inhomogeneities, T_c Suppression and M-I Transition in Ni-Doped $La_{2-x}Sr_xCu_{1-y}Ni_yO_4$*
International Symposium on Physics in Local Lattice Distortions (LLD2K), Tsukuba, Japan (2000)

- (*Invited Talk*) *Role of Sr dopants in the inhomogeneous ground state of $\text{La}_{2-x}\text{Sr}_x\text{CuO}_4$*
Phase Transitions and Self-Organization in Electronic and Molecular Networks
Cambridge University, Cambridge, England (2000)
- (*Talk*) *Where do the doped holes go in $\text{La}_{2-x}\text{Sr}_x\text{CuO}_4$? A close look by XAFS*
High Temperature Superconductivity (HTS99), Coral Gables, Florida USA (1999)
- X-ray tomography with Kirkpatrick Baez mirrors focusing at the PNC-CAT beamline*,
K. H. Kim, E. A. Stern, S. Heald, D. L. Brewster, D. Haskel, D. Jiang,
Ninth users meeting for the Advanced Photon Source, Chicago, USA (1998)
- (*Talk*) *Structural disorder and the origin of high T_c suppression in $\text{La}_{1.875}\text{Ba}_{0.125}\text{CuO}_4$*
International XAFS conference, Chicago, USA (1998)
- Towards atomic resolution EXELFS?*,
M. Qian, D. Haskel, E. A. Stern and M. Sarikaya
Towards atomic resolution analysis (TARA98), Port Ludlow, Washington State, USA (1998)
- (*Talk*) *Disordered LTT structural ground state in $\text{La}_{2-x}\text{Ba}_x\text{CuO}_4$* ,
March Meeting of the American Physical Society, Los Angeles, CA, USA (1998)
- Altered Sr environment in $\text{La}_{2-x}\text{Sr}_x\text{CuO}_4$* ,
D. Haskel and E. A. Stern,
Gordon Research conference on High T_c superconductivity, Ventura, CA, USA (1997)
- (*Talk*) *Development of EXELFS for nanoscale atomic structure determination*
International XAFS conference, Grenoble, France (1996)
- Ultimate spatial resolution in the EXELFS of Inorganic Materials*,
D. Haskel, M. Qian, M. Sarikaya and E. A. Stern
Microscopy Society of America (MSA) Annual Meeting, Minneapolis, Minnesota, USA (1996)
- (*Talk*) *XAFS studies of phase transitions in $\text{La}_{2-x}\text{Sr}_x\text{CuO}_4$*
March Meeting of the American Physical Society, San Jose, CA, USA (1995)

PUBLICATIONS IN CONFERENCE PROCEEDINGS

- Hard x-ray magnetic circular dichroism study of a surface-driven twisted state in Gd/Fe multilayers*,
D. Haskel, Y. Choi, D.R. Lee, J. C. Lang, G. Srajer, J. S. Jiang and S. D. Bader
Journal of Applied Physics, *in press* (May 2003).
- Imaging buried magnetic domains using hard x-rays*,
J. C. Lang, J. Pollmann, D. Haskel, G. Srajer, J. Maser, J. S. Jiang and S. D. Bader
X-ray micro- and nano- focusing: applications and techniques II
SPIE Conference Proceedings **4499**, p. 1 (2001).
- Wide-field x-ray microscopy with Kirkpatrick-Baez optics*,
T. Jach, S. Durbin, A. Bakulin, D. Bright, C. Stagaescu, G. Srajer, D. Haskel, and J. Pedulla
X-ray micro- and nano- focusing: applications and techniques II
SPIE Conference Proceedings **4499**, p. 38 (2001).
- The use of resonant X-ray magnetic scattering to examine UAs-USE solid solutions*,
M. J. Longfield, J. Wilmshurst, L. Buchenoire, M. J. Cooper, D. Mannix, G. H. Lander, N. Bernhoeft, A. Stunault, W. G. Stirling, J. Pollmann, D. Haskel and G. Srajer.
Journal of Magnetism and Magnetic Materials **233**, p. 53 (2001).
- Suppression of superconductivity in $\text{La}_{1.85}\text{Sr}_{0.15}\text{Cu}_{1-y}\text{Ni}_y\text{O}_4$: The relevance of local lattice distortions*,
D. Haskel, E. A. Stern, F. Dogan, and A. R. Moodenbaugh
in *Physics in Local Lattice Distortions*, AIP Conference Proceedings **554**, p. 154 (2001).

- Role of Sr dopants in the inhomogeneous ground state of $\text{La}_{2-x}\text{Sr}_x\text{CuO}_4$,*
D. Haskel, E. A. Stern, and F. Dogan
in *Phase Transitions and Self-Organization in Electronic and Molecular Networks*,
edited by J. C. Phillips and M. F. Thorpe (Kluwer Academics/Plenum Publishers, NY 2001).
- Where do the doped holes go in $\text{La}_{2-x}\text{Sr}_x\text{CuO}_4$? A close look by XAFS,*
D. Haskel, V. Polinger and E. A. Stern
in *High Temperature Superconductivity*, AIP Conference Proceedings **483**, p. 241 (1999).
- Why does Ni suppress superconductivity in $\text{La}_{1.85}\text{Sr}_{0.15}\text{Cu}_{1-y}\text{Ni}_y\text{O}_4$?,*
D. Haskel, E. A. Stern, V. Polinger and F. Dogan
J. Synchrotron Rad. **6**, p. 758 (1999).
- Structural disorder and the origin of high T_c suppression in $\text{La}_{1.875}\text{Ba}_{0.125}\text{CuO}_4$,*
D. Haskel, E. A. Stern, F. Dogan and A. R. Moodenbaugh
J. Synchrotron Rad. **6**, p. 755 (1999).
- Electronic states of doped holes in $\text{La}_{2-x}\text{Sr}_x\text{CuO}_4$: a unique application of XAFS,*
E. A. Stern, V. Polinger and D. Haskel
J. Synchrotron Rad. **6**, p. 373 (1999).
- Development of EXELFS for Nanoscale Atomic Structure Determination,*
D. Haskel, M. Qian, E. A. Stern and M. Sarikaya
J. Phys. IV France **7**, p. C2-557 (1997).
- Altered Sr atomic environment in $\text{La}_{2-x}\text{Sr}_x\text{CuO}_4$,*
D. Haskel and E. A. Stern,
J. Phys. IV France **7**, p. C2-1177 (1997).
- Radiation damage and spatial resolution in the EXELFS of inorganic materials,*
D. Haskel, M. Sarikaya, M. Qian and E. A. Stern,
Microscopy and Microanalysis '96, p. 558 (1996).
- Single and multiple scattering XAFS in BaZrO_3 : a comparison between theory and experiment,*
D. Haskel, B. Ravel, M. Newville and E. A. Stern,
Physica B **208&209**, p. 151 (1995).
- Analysis of multiple scattering XAFS data using theoretical standards,*
M. Newville, B. Ravel, D. Haskel, J. J. Rehr and E. A. Stern,
Physica B **208&209**, p. 154 (1995).
- The UWEXAFS analysis package: philosophy and details,*
E. A. Stern, M. Newville, B. Ravel, Y. Yacoby and D. Haskel,
Physica B **208&209**, p. 117 (1995).
- Anomalous temperature behavior of impurities in lead and silver hosts,*
M. Newville, E. A. Stern, D. Haskel, H. Shechter, and Y. Yacoby
Jpn. J. Appl. Phys. **32** suppl. 32-2, p. 125 (1993)

PROFESSIONAL ASSOCIATIONS

Member of American Physical Society

Member of the International XAFS Society

REFERENCES

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